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HEALTH CONTROL OF
FOUR-YEAR-OLD CHILDREN

AN EPIDEMIOLOGICAL STUDY OF CHILD HEALTH

BY LENNART KÖHLER

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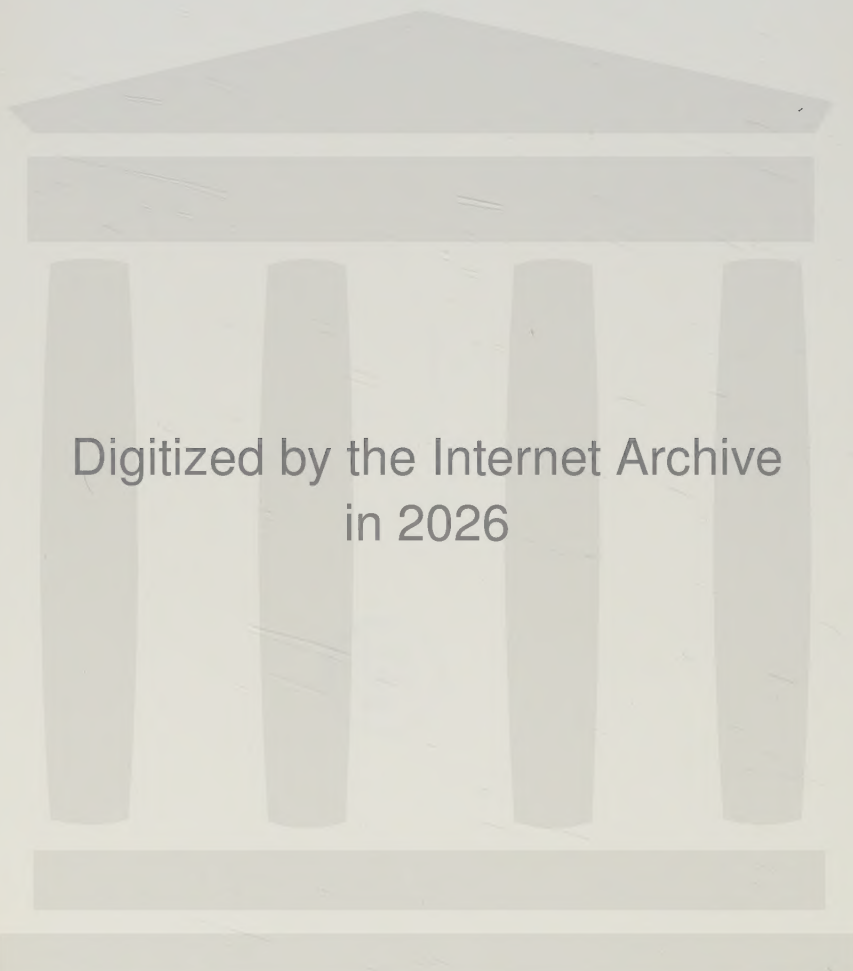
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CONTENTS

I	Introduction and background	7
II	Planning and organization of the health control	8
1.	Purpose	8
2.	Cooperation with other specialists	8
3.	Program	8
4.	Personnel and equipment	8
5.	A nation-wide health control of 4-year-old children	9
III	Population	9
1.	General description of the area and the population	9
2.	Selection of children	10
3.	Participation in the study	10
4.	Non-attendance	11
4.1	Medical care	11
4.2	Reasons for non-participation	12
4.3	Social background	12
IV	Practical performance of the health control	13
1.	Invitation	13
2.	Examinations	13
3.	Registration of data	14
V	Methods of examination and their applicability in the study	14
1.	Questionnaire	14
2.	Physical examination	15
3.	Vision screening	16
4.	Auditory screening	17
5.	Dental examination	17
6.	Urinary screening	17
VI	Physical health problems	18
1.	Functionally important health problems	19
2.	Previously known and newly detected health problems	21
3.	Characteristics of the functionally important health problems	22
4.	Characteristics of the children	22
5.	Comparisons with other studies	23
VII	Conclusions and implications	24
VIII	Acknowledgements	26
IX	References	27

This report is a discussion and evaluation of a health control of 4-year-old children.

It is based on the following original papers:

I. Lennart Köhler: Physical examination of four-year-old children, *Acta Pædiat Scand*, 62:181–192, 1973

II. Lennart Köhler and Göran Stigmar: Vision screening of four-year-old children. *Acta Pædiat Scand*, 62:17–27, 1973

III. Lennart Köhler and Hans-Eric Holst: Auditory screening of four-year-old children. *Acta Pædiat Scand*, 61:555–560, 1972

IV. Lennart Köhler and Kerstin Holst: Dental health of four-year-old children. *Acta Pædiat Scand*, 62, 1973

V. Lennart Köhler and Kerstin Holst: Malocclusion and sucking habits of four-year-old children. *Acta Pædiat Scand*, 62, 1973

VI. Lennart Köhler, Hans Fritz and Bengt Scherstén: Health control of four-year-old children. A study of bacteriuria. *Acta Pædiat Scand*, 61:289–295, 1972

In the text, the above papers will be referred to by their roman numerals I–VI.

I. INTRODUCTION AND BACKGROUND

Preventive paediatrics in Sweden is administered by the County Council's Child Health Centres, under the supervision of the National Board of Health and Welfare. For a population of approximately 800 000 pre-school children, there are about 1400 Child Health Centres (*Barnvårdscentraler*), in 1966 supervising 600 000 children (2). Two types of Child Health Centres exist: Type I, staffed by a paediatrician and a specially trained children's nurse, and Type II, staffed by a County Medical Officer and a Public Health Nurse. They each serve roughly half of the population of children.

According to regulations, these centres should provide regular health controls of physical, mental and social development. They occur 4–7 times during the children's first year of life, twice during their second year and, later on, once a year until school begins at 7 years of age (48). The participation in these health controls is voluntary and free of charge for the parents. Personnel and equipment costs are paid for by the counties. During the infant year, the children participate to almost 100%, but as they grow older, the attendance rate diminishes rather rapidly, and at the age of 4 years, only about half of the children visit the Health Centres (2).

Among medical and social authorities in Sweden, discussions have been held on how to provide more of our pre-school children with preventive care and how to do it efficiently, so that more disabling conditions can be detected and treated earlier. As it was, many milder chronic diseases and minor handicaps were not diagnosed and treated prior to the children's school entry (2).

One way of obtaining an early recognition of handicapping disorders in childhood is to clinically select infants considered to be specially liable to develop handicaps. This risk group of children

should then be kept under close surveillance. In spite of considerable enthusiasm for the idea, mainly in Great Britain, the results have been disappointing. Not only did these risk groups come to include merely a part of the children with subsequent somatic handicaps (23, 56) but they also included children who grew up to be perfectly normal (50). Besides, most emphasis was laid on physical deviations, tending to overlook social and emotional factors, and also tending to neglect children not on the register (21). Although theoretically an attractive idea, there are still many problems to be solved before a risk register can function in practice.

Another way of improving the health surveillance of the pre-school children is to introduce special and more elaborate examinations at certain ages, and to do so in a way that makes the parents recognize the investigation as being important for their children's health. This type of procedure should therefore ensure an efficient health examination and a high participation.

As early as 1964, this type of point examination was discussed and planned at the Department of Paediatrics in Lund. The intention was to start a comprehensive epidemiological pilot study of child health in a smaller area, and then, based on these experiences, introduce it to other areas in the county.

In a growing child, it is evident that the earlier a disability is detected and the earlier suitable treatment can be instituted, the better results may be expected. On the other hand, if minor handicaps are also to be found, e.g. in the field of mental development, vision and hearing, the cooperation of the child is of great importance. After carefully weighing up these different factors, we chose the age of 4 years as the most suitable for this investigation.

II. PLANNING AND ORGANIZATION OF THE HEALTH CONTROL

II.1. Purpose

The main purpose of this child health investigation was:

1. To study during the pre-school-age the frequency and types of disabilities and handicaps which may influence the present and future function of the child. Special interest was directed to disabilities not previously detected or cared for.

2. To develop and test valid and time-saving methods to detect these disabilities.

3. To test an administrative and organizational form for this type of child health study.

4. On the basis of our findings, it should be possible to suggest improvements to the ordinary Child Health Services regarding methods, personnel and organization.

For reasons of availability and convenience, children in the city of Lund were chosen as the first population to be studied. One year later, children from Dalby, a rural district just outside Lund, were included.

II.2. Cooperation with other specialists

Naturally, the discovery of health problems or defects is of no interest whatsoever if there exist no ways or means of treating or alleviating these conditions. Therefore, it was very important to plan and perform this investigation in close cooperation with the specialists, inside and outside the hospital, who were to further investigate and treat children, referred to them from the health control. A continuous exchange of experience and information was maintained between specialists from the different fields represented in the investigation (paediatrics, ophthalmology, audiology, odontology, educational psychology, public health and administration).

III.3. Program

The program designed for the health control included the following items:

1. *A thorough physical examination*, performed by a paediatrician.
2. *A vision screening*, performed by nurses
3. *An auditory screening*, performed by nurses

4. *An evaluation of the mental development and social adaptation* performed by a psychologist

5. *A dental examination*, performed by a dentist

6. *A laboratory screening* of blood and urine, performed by nurses.

II.4. Personnel and equipment

The personnel immediately attached to this project, consisted of one paediatrician (the author), one psychologist, one dentist, one registered nurse, one children's nurse and one secretary. The appointment as registered nurse was held by 3 persons during the study, the remaining staff being the same throughout the investigation. Before their work started, the nurses went through theoretical and practical courses at the Departments of Ophthalmology and Audiology, learning how to perform screening of vision and hearing. Since the success of accomplishing these screening examinations basically depends on the screener's ability to establish a warm and confident contact with the children, nurses with training and experience of children should make the best examiners. The time and skills of ophthalmologists, orthoptists and audiometrists should be reserved for diagnosing and treating children referred to them by means of the screening program.

A child Health Centre with ample space was available in Lund as premises for the study. Great effort was spent in making the surroundings look different from those of a hospital: ordinary living-room furniture was used whenever possible, and textiles and walls had warm, gay colours. In Dalby, the ordinary office of the district nurse was used. For economical and practical reasons, the dental examination took place at the Department of Public Dental Health. The personnel wore their own clothes, no white coats being allowed except for the dentist, who needed them as protection. The possibilities for carrying out a health control of this kind depends to a great extent on the children's cooperation, and as it could be anticipated that many children had memories of painful visits to doctors, it seemed reasonable not to remind them too obviously of these consultations.

II.5. A nation-wide health control of 4-year-old children

Shortly after the planning of our project was started, the Minister for Social Affairs instituted an analysis of Child Health Care in Sweden, and, subsequently, the National Board of Health and Welfare worked out a program for a general health control of all 4-year-old children in the country, to be started in 1969 (2). The purpose of this health control was to bridge the gap of efficient health

care between infancy and school age, i.e. partly the same as in our investigation, and the program was similar. Our project was adopted as a pilot study and supported by grants from the Ministry. A preliminary report from the first part of our study was published in 1969 (26). Also other pilot studies, although differently designed and organized were started later on. Hitherto, short, descriptive results have been presented from Uppsala (74), and Göteborg (5).

III. POPULATION

III.1. General description of the area and the population

Lund and Dalby are situated in southern Sweden (see map, Fig 1). Lund is a city of about 50 000 inhabitants, a centre of education, medical care, and administration, dominated by the university (20 000 students) and large university and county hospitals.

Dalby, in this context, means the communities of Dalby, Genarp and Veberöd, with a population of about 8 500. Parts of it are still mainly farming areas, while other parts have expanded rapidly during the last decade and become increasingly like a suburb. The differences in the main industry among the population of Lund, Dalby and the whole country are evident from Table 1.

The influence of the social environment upon growth and development, health and disease has been confirmed in many studies and is now common knowledge. Therefore, in a study of child

Table 1. Relative distribution of main industry among economically active population of Lund, Dalby and the whole country

Population and housing census 1965.

Main industry	Lund (%)	Dalby (%)	Whole country (%)
Agriculture etc	2	26	10
Manufacturing and construction	31	40	44
Trade and communication	18	20	23
Public service	49	14	23
	100	100	100

health it is necessary to include some kind of description of the way of life of the children and their families. Usually, some more or less elaborate stratification of the population into social or economic groups is practised. In Sweden, the classification into 3 socio-economic classes or



Fig. 1. Map of Scandinavia, showing the areas studied.

groups has been widespread (I upper class, II middle class, III working class) (16) although the method has been heavily criticized as being inadequate, unreliable, and unfair, and not suitable in our modern society (25). A new classification into 11 occupational groups is proposed, partly based on an international system (25).

However, in a relatively small survey of this kind, it is only possible to use a few groups. Therefore, although well aware of its limitations, we chose to revive once again the old 3-graded socio-economic classification system, which pays attention to the occupation, and indirectly to the education and economy of the head of the family, usually the father. The mother's occupation is not usually reflected in this classification, but in some comparisons within our study, where the mother's role was considered especially important, her education was used as a parameter (e.g. principles of upbringing, oral hygiene). Of course, when the mother is single, the socio-economic classification is based on her occupation.

It must be emphasized that class distinction in Sweden is not very pronounced (42). The excellent economic situation of the country combined with strong political goals including extensive social welfare, have brought about a far-reaching social equality (63).

To all intents and purposes the lowest class, corresponding to many foreign classifications, has been eliminated, and with it the disadvantages and opprobrium attached to such a designation (42).

The distribution of the parents of our 4-year-old children on the socio-economic groups are shown in Table 2, as well as the percentage of parents with academic education. Although the figures from Lund and Dalby in Tables 1 and 2 are not altogether comparable with those from the whole country, they give, nevertheless, a rough idea of the situation. Since these very important background variables show such a great disparity from the conditions in the whole country, it is also probable that the results from this limited survey cannot be regarded as altogether valid for the whole country.

III.2. Selection of children

The county population register, stored on magnetic tapes and up-dated every week, was used to select children aged 4 years and living permanently

Table 2. *Relative distribution of socio-economic groups and academic education among families of 4-year-old children in Lund and Dalby and among the population of the whole country*

	Parents of 4-year-old children in		Population of the whole country
	Lund (%)	Dalby (%)	(%)
<i>Socio-economic group</i>			
I	31.7	9.3	10.5
II	35.4	39.6	52.1
III	32.9	51.1	37.4
	100.0	100.0	100.0 ^a
<i>Academic education of parents</i>			
husband only	16.9	4.5	3.2
wife only	2.9	1.1	0.2
both	19.1	1.1	0.7
total	38.9	6.7	4.1 ^b

^a Refers to a sample of the country's households with children aged 2–6 years (67).

^b Refers to households with children under 7 years of age (8).

in Lund and Dalby. Thus, every child on the official register was included even though temporarily absent. Children living temporarily in the areas but registered elsewhere were excluded. Information on children moving into the areas during their 4th year of life was collected continuously, and these children were included in the study. Correspondingly, children moving out of the areas before their 4th birthday were excluded.

III.3. Participation in the study

The population of 4-year-old children born 1963–1965, and living in Lund and Dalby during 1967–1969, as well as their participation in the main study is shown in Table 3. The difference in the attendance rate between Lund and Dalby was not significant ($p > 0.05$). Slightly more boys than girls participated ($p < 0.05$).

For economic and practical reasons, the study of bacteriuria was limited to children born in 1963–1964, and the main dental study to children in Lund born 1963–1964, and in Dalby to children born in 1964–1965 (see Papers IV, V and VI).

Table 3. *Population of 4-year-old children and their participation in the health control*

	Invited children			Participating children					
	Boys	Girls	Total	Boys		Girls		Total	
				n	%	n	%	n	%
Living in Lund	1 183	1 113	2 296	1 136	96.0	1 043	93.7	2 179	94.9
Living in Dalby	141	136	277	136	96.5	132	97.1	268	96.8
Total	1 324	1 249	2 573	1 272	96.1	1 175	94.1	2 447	95.1

The participation in our study was indeed very high, 2447 out of 2573, or 95.1%. It proves that one of our aims was achieved, i.e. to construct and carry out a health service that was convenient and accessible for parents and children and also recognized by the parents as being important for their children's health. Of course there were several factors which facilitated the performance of our health control. Firstly, Sweden has a long history of efficient population statistics, dating back to 1749, and claimed to be the oldest in the world. Today, the registers are even more reliable, up-to-date, and easily accessible by the use of computers. Secondly, the study was performed in a limited, densely populated area with small distances and no communication problem.

Thirdly, it is unquestionable that the population in these areas is unusually well equipped and prepared to fill in questionnaires, to be interviewed and to participate in examinations of different kinds, partly because a large proportion of the inhabitants have an academic education, and partly because people are used to scientific investigations from various university institutions. Fourthly, the support of the project among the authorities and specialists was so positive, that we were allowed to plan and perform the study under optimal conditions as regards personnel, equipment, premises, and use of hospital facilities for the follow-up of referred children.

III.4. Non-attendance

In spite of every effort to obtain a full cooperation, the problems of non-attendance are unavoidable in a health control of this kind. It is often argued that those not wishing to cooperate are non-representative of the total group in many respects (27, 57). It would therefore be interesting to study their background, health and reasons for noncooperation.

III.4.1. *Medical care.* For the 126 children who did not participate in the study, records from the Child Health Centres, from the Children's Hospital (in- and out-patient wards), from the Eye Clinic, from the Audiology Clinic and from the Surgical and Orthopaedic Clinics were scrutinized. Altogether, 15 children were under current professional care due to handicapping disorders (Table 4). Ten of these children were taken care of by mainly one clinic and 5 by 2 clinics. Their handicaps are mentioned in papers I, II and III. It may be assumed that their parents had a valid excuse for not participating in a health control.

Out of the remaining 111 children, information could be collected on 84 from the various medical records. Generally, the visits to the Child Health Centres were infrequent, and during the last year only 18.8% had visited a Child Health Centre, compared with 41.3% of the participating children.

In general, the appointments at the Children's Hospital concerned minor ailments such as infections, rash and eczema.

It seems unlikely, however, that major physical handicaps would have been overlooked at these visits, although it is quite conceivable that some deviations, not easily detected without proper examination, may hide among these children, e.g.

Table 4. *Non-attendant children under professional care for handicapping disorders*

Clinic	Number of children		
	Boys	Girls	Total
Children's Hospital	5	5	10
Eye Clinic	2	5	7
Audiology Clinic	1	2	3
Total number of children under professional care	6	9	15

vision and hearing defects, bacteriuria, caries, social understimulation and intellectual subnormality. Actually, at the compulsory health control in school at the age of 7 years, 2 out of these 84 children have already been found to have deep amblyopia, and 1 to have bacteriuria.

No information was available from any records for 27 of the children.

III.4.2. Reasons for non-participation. The reasons for the non-participation of the 111 children not under care for handicapping conditions were investigated by trained interviewers, who visited the parents in their homes. Parents of 85 children were traced and interviewed. As can be seen in Table 5,

Table 5. *Reasons for non-attendance. Interview of parents of 85 children*

Several reasons may be given

Reasons	Number of children	
	n	%
No time	38	44.7
Child ill	8	9.4
Parents negative to health controls	16	18.8
Children negative to examinations	8	9.4
Regularly health controlled by other doctors	12	14.1
Other reasons	27	31.8

the reasons given could be roughly divided into 3 parts: those who were unable to attend, those who refused to attend and those who were already attended to. These reasons are the same as those reported from health controls of adults (68). From the children's and also from our point of view, these parental explanations are not satisfying, since none of them can exclude disabilities in the children.

Table 6. *Some socio-economic variables among participants and non-participants*

	Partici- pants (%)	Non-parti- cipants (%)
Socio-economic group		
I	32.1	31.0
II	34.4	24.6
III	33.5	44.4
Academic education of father or mother	35.4	25.4
Dwelling		
modern	90.4	76.5
semi-modern	6.1	11.8
un-modern	2.1	8.2
Single parent	8.4	11.9

III.4.3. Social background. It is often said that hard-to-reach families belong to lower socio-economic groups (14, 49) and that the families' need for advice and support is greater than that of other families (2). To test this hypothesis a comparison was made between the participants and the non-participants regarding some available socio-economic factors. As shown in Table 6, non-participating families seem to have a somewhat poorer socio-economic background, the difference in socio-economic groups and academic education being significant at the 5% level, in standard of dwelling at the 0.1% level. No difference was found regarding "incomplete" families ($p > 0.05$).

Another method of judging the families' social wellbeing is to consider their need for social assistance, reflected by Public assistance received (*Socialbidrag*), attention by the Child Welfare Committee (*Barnavårdsnämnd*) or the Temperance Board (*Nykterhetsnämnd*). The social registers were scrutinized in these respects and the findings for our non-attendant families were compared with those of a control group. For each of the 126 non-attendants, a child of the same sex and

Table 7. *Need for social assistance in 126 non-attendant families and 126 control families*

Type of social assistance	Non-attendant families		Control families	
	n	%	n	%
Public assistance	22	17.5	9	7.1
Attention by Child Welfare Committee	19	15.1	6	4.8
Attention by Temperance Board	4	3.2	1	0.8
Total number of families with social assistance	34	27.0	14	11.1

socio-economic group, born on the same day or on one of the immediate following days, was selected among the participants and constituted the control group.

The result of this comparison is shown in Table 7. 27.0% of the families of the non-attendant children were found in the social registers as compared with 11.1% of the control group. The difference is significant at the 1% level.

Thus, the hypothesis was proved to be correct: the non-attendant families had less education, a more burdened social situation and they provided less health care for their children. Although the participation in this epidemiological study of child

health was very high, it is strongly desirable with regard to health services that these hard-to-reach families are also included and surveilled in a Child Health Program. Therefore, even greater efforts must be made to reach the whole child population by making the service more meaningful, convenient and available, and by administering it so as to protect the time, money and dignity of the recipients (49). Offering favourable conditions is, however, not always sufficient; it is often necessary to personally get in touch with these parents and explain to them the purpose and the benefits of the investigation.

IV. PRACTICAL PERFORMANCE OF THE HEALTH CONTROL

IV.1. *Invitation*

Shortly before their 4th birthday, the children were invited to participate in the health control by a letter to their parents. The invitation described the purpose of the investigation and the different items included, and presented the investigators by name and title. It also reassured the parents that all information about the family would be treated confidentially and that detected deviations would be cared for after full discussion with the parents. Finally, a date and a time was suggested for the first appointment. The invitation was accompanied by a questionnaire to be delivered, filled in, at the first visit to the Child Health Centre. If the appointment was not kept, the parents were reminded several times, first by mail and then by telephone. Sometimes a personal call to their homes was made.

IV.2. *Examinations*

Since the health control was designed to be comprehensive and included several time-consuming items, it was divided into 3 parts. It meant that the children and the parents had to attend on 3 separate occasions. On the other hand, a child of 4 years could hardly be expected to cooperate fully during 2–3 hours of examination. At the first visit, the screening of vision and hearing and the physical examination, including laboratory examinations, were performed. Since a major

problem both in vision and hearing screening is one of cooperation, i.e. to catch and keep the children's attention, the examinations were performed in rapid succession, in the same room and by the same examiner. Usually, 15 min was enough for the two screening procedures. When the child failed the screening at the first trial, a new test was performed on a later occasion. After a second failure, the children were referred for further examination to the ophthalmologist or the audiologist.

After a short rest in the waiting-room, the physical examination, which took 20 min, was carried out. All findings were discussed with the accompanying parent, and advice and treatment for minor medical problems were offered. Children with health problems considered to be functionally important at the present or in the future and not under current professional care were referred for further evaluation and treatment to the respective departments of the University Hospital of Lund.

At a second visit, the evaluation of the mental development and social adaptation was performed by the psychologist. The children were observed and examined in groups of 4–5 according to a standardized scheme. Afterwards, each mother was interviewed separately, the questionnaire scrutinized, and problems of behaviour and development were discussed. Advice was always given;

sometimes psychological and educational treatment was also instituted. When necessary, the child was referred for further psychological, medical and social evaluation and treatment. A part-report on the psychological investigations, purpose, methods, results and follow-up is given elsewhere (32-34).

The dental examination was carried out at a third visit at the Department of Public Dental Health. The examination itself took an average of 20 min, and was followed by a 30 min discussion with the mother regarding the child's eating and sucking habits, oral hygiene and earlier dental care. In Dalby, where medical and dental facilities are situated in the same building, visits 2 and 3 were performed successively on the same day. Children with caries and need for orthodontic care were referred for treatment.

IV.3. *Registration of data*

Standardized forms for the various examinations and for referral were constructed. When the record was completed and the examination finished, data from the questionnaire and examination forms were transferred to punched cards and stored on magnetic tapes. No printouts were made by the computer, but the original record was kept at the Child Health Centre. Statistical computation of the material was later performed at the Computer Centre of Lund University (Univac 1108), using general computer program (69) as well as specialized programs, designed for this investigation. Minor statistical analyses (chi-square, tests for normal distribution) were performed on a desk-computer (Olivetti Programa 101).

V. THE METHODS OF EXAMINATION AND THEIR APPLICABILITY IN THE STUDY

The traditional way of providing health care for children is to offer periodical medical evaluation. These evaluations consist mostly of history-taking and examinations, and are usually performed by specialists, mainly physicians. Lately, other approaches to identify health problems have been introduced into the Child Health Services, e.g. screening by tests, by examination, by observation and by interview performed by non-physician personnel (15) and using questionnaires completed by parents or teachers (49).

In this study, traditional medical evaluation (physical examination, Paper I, and dental examination, Papers IV and V) was used as well as screening by specific tests (vision examination, Paper II; auditory examination, Paper III; examination of bacteriuria, Paper VI), screening by examination (neurological examination, Paper I), screening by observation (psychological examination (33), screening by interview (psychological examination (33), and dental examination, Papers IV and V, and a parental questionnaire.

In addition, records from the Children's Hospital, from the Eye Clinic and from the Audiology Clinic were scrutinized to identify children with previously known important physical disorders.

Unfortunately, records from the Surgical and Orthopaedic clinics could not be checked, as they are filed according to day of birth, not year of birth. However, children with serious surgical or orthopaedic disorders are almost invariably also investigated by paediatricians, and, therefore, these children should be found in the files of the Children's Hospital.

Although there are a few private paediatricians, ophthalmologists and otologists in the area, our experience is that it is highly improbable that the facilities and resources of the University Hospital are not used for assessing and treating children with handicapping disorders. Thus, records of children, who are controlled and treated mainly by private doctors should also be found at the hospital.

V.1. *Questionnaire*

Some information on the children's health, development, previous and present adaptation problems and the family's social standard was desirable to serve both as anamnesis before the medical and psychological examinations, and as an

instrument for identifying children at high risk of having health problems.

Familiarity with the ordinary records kept at the Child Health Centres convinced us that they were highly unsuitable for these purposes: their information is unstandardized, incomplete and sometimes inadequate. Furthermore, for a great part of the children, these records do not cover more than the first years of their lives. Therefore, other sources and methods must be used. Much useful information about the children and their families can be found in records from the hospitals' in- and outpatient wards, from private doctors, from social registers, but it was considered too time-consuming, expensive and inconvenient to collect all these widely scattered data.

A questionnaire, i.e. a self-administered medical history-taking, has several advantages (45):

1. All patients are asked the same questions, formulated in the same manner.
2. The questions are answered at home, i.e. in a familiar and unstressed surrounding.
3. Much time is saved for the physician and the nurse in the collecting of data.
4. The information may easily be coded and stored in a computer, facilitating retrieval of data.
5. The influence of the examiner is reduced or eliminated, as compared with the dialogue method.

By a follow-up of the answers in the questionnaire with further questions, some of the disadvantages with this method were removed: completion of omitted answers could be made and fuller information on specific points could be gathered, and, also, the benefit of a personal contact with the parents was enjoyed.

All retrospective collection of data gives a certain unreliability to statements of events that took place a long time before the investigation (6, 13, 41, 72).

However, for our purposes, a questionnaire to the parents was considered the most suitable way of collecting basic information about the child and its family. The questions were mostly of the fixed choice type, i.e. "yes", "no", or a multiple choice list, although ample space was left for narrative comments. Completion of omitted answers was made when possible during the medical examination. An evaluation regarding reliability and validity of the psychological and educational part of the

questionnaire was made in an intensive pilot study of a sample of the material (33). Both reliability and internal and external validity were found to be adequate for the purposes of the study.

Although the questionnaire was a lengthy one, the parents tried hard to answer all the questions.

By computing information from the questionnaires regarding symptoms and signs, previous and present health, birth complications, and heredity, with actual findings of physical disorders it was possible to designate certain children as being at risk of having, e.g., vision and hearing disturbances, bacteriuria, or neurological deviations (see Papers I, II, III and VI).

However, the ability of this parental information to identify children, who by other methods of examination were found to have physical disorders, was very low, i.e. the relative sensitivity (see page 16) of the questionnaire was inadequate. Hence, the questionnaire was not suitable as a screening instrument.

V.2. Physical examination

Since no specific screening tests are available to detect physical health problems or handicaps at this age (10), other procedures were applied: ordinary clinical evaluation by examination and by observation. The methods are well-known and used in every-day practice by all paediatricians. The examination was rather detailed and was performed carefully and thoroughly. The procedures — examinations, observations and registrations — followed a strictly standardized scheme.

In order to diagnose and treat a sick child, a physical examination can always be performed also against the child's will. However, a health control carried out to detect even minor deviations of health and function must rely to a great extent on the child's cooperation. Therefore, great effort was spent in attracting and keeping the children's interest throughout the examination by including items which were fun for the children at the same time as they gave valuable information to the examiner. Examples of such items were pouring water into cups, running, hopping on one leg, cutting with a pair of scissors, playing with beads. Procedures least likely to disturb the child were carried out first, such as looking at the hands, and noting the active power in the arms, while procedures which might excite or frighten were post-

poned to the end, e.g. measuring the blood-pressure and the hæmoglobin concentration. In this way, full cooperation was reached in 99.5% of all children. In the few uncooperative children at least some of the motor functions could be studied as they struggled to get out of the room!

V.3. Vision screening

One of the reasons for postponing this health control to the age of 4 years was that this age was presumed to be the earliest one at which specific mass screening tests, involving a great deal of cooperation (e.g. testing of vision) could be used on the majority of the children.

Many tests have been used and recommended for pre-school vision screening, although only few of them have been critically evaluated, regarding both overreferral and underreferral. The Marquez-Boström's hooks, widely used in Sweden, is one of them. In order to detect strabismic children with normal visual acuity, a cover test and a test of the binocular function (Stereo-fly-test) were also included. The tests were easy and quick to carry out and a complete examination could be performed on 98% of the children.

The usual way of evaluating a screening test is to calculate the sensitivity and the specificity. The use of these conceptions, however, requires that a diagnosis is established or ruled out for every person tested by the screening procedure, regardless of whether the person screened negative or positive (70). This type of evaluation was made in our study of bacteriuria (Paper VI). For economic reasons, it was not possible to offer each child a full ophthalmological examination, and, instead, we tried to evaluate the screening methods by using control groups and by rescreening the children when they began school at 7 years of age. So far, results from the school-screening are only available for some of our children, but the follow-up continues.

The control groups and the follow-up at school showed that few children needing ophthalmological treatment were missed, and, most important, that no children with functional amblyopia or strabismus passed the screening tests.

For purposes of comparison between the 3 screening tests, the relative sensitivity and specificity may be calculated, assuming that children negative to all of the tests are truly free from eye

disorders (70). In that way, the relative sensitivity of the visual acuity test was 97.0%, the fly test 11.7% and the cover test 7.4%, while corresponding figures for the relative specificity were 97.4%, 99.6% and 99.8% (Table 8).

It was also found that the adapted screening level of 5/6 was appropriate. A lowering of the passing standard to 5/10 would reduce the overreferral from 15.5% (53 out of 343 referred for failing the 5/6 level) to 7.7% (13 out of 168 failing the 5/10 level), but at the same time 25.5% (38/149) of all children needing treatment would then have been overlooked (Paper II, Table 4). In other words, the relative specificity would increase

Table 8. Relative sensitivity and specificity of 4 different screening procedures to detect eye disorders

Screening test result	Diagnosis		
	Eye disorder	No eye disorder	Total
1. Visual acuity test, screening level 5/6			
Positive	290	53	343
Negative	9	1972	1981
Total	299	2025	2324 ^a
Relative sensitivity = $\frac{290}{299} \times 100 = 97.0 \%$.			
Relative specificity = $\frac{1972}{2025} \times 100 = 97.4 \%$.			
2. Visual acuity test, screening level 5/10.			
Positive	155	13	168
Negative	144	2012	2156
Total	299	2025	2324 ^a
Relative sensitivity = 51.8 %.			
Relative specificity = 99.4 %.			
3. Wirt Fly Stereo test			
Positive	35	9	44
Negative	264	2016	2280
Total	299	2025	2324 ^a
Relative sensitivity = 11.7 %.			
Relative specificity = 99.6 %.			
4. Cover test			
Positive	22	4	26
Negative	277	2021	2298
Total	299	2025	2324 ^a
Relative sensitivity = 7.4 %.			
Relative specificity = 99.8 %.			

^a 67 children under professional care are excluded.

to 99.4%, but the relative sensitivity would decrease to 51.8% (Table 8). Such a modification of the visual acuity test could therefore not be accepted.

Thus, it could be concluded that the present visual acuity test is accurate enough as a screening method for eye disorders in pre-school children. Both the cover test and the fly test are too unreliable to be used as the only methods. In an ambitious program, however, they may be used as a complement to the visual acuity test.

V.4. Auditory screening

In general, the ordinary mass screening methods to detect hearing defects cannot be carried out until the child is past the age at which special treatment of these defects should begin (15).

More refined screening techniques, useful for even newborn infants have been designed, but are not commonly used or even recommended as routine methods (12). Lately, a new "contact"-test to screen for the infant's ability to hear and to listen, has been constructed and tested on a small scale (3, 29). Until the results of this and other methods have been confirmed in more extensive studies and follow-ups we must rely on skilled as well as unskilled observation in order to detect hearing impairment in small children.

The pure-tone audiometry is well suited for the screening of somewhat older pre-school children, especially if the play-audiometry principle is used, as in this study. The method was easy to learn for the nurses, the examination took 8 min on average and could be performed on 98.9% of the children.

The sound intensity used as the passing level for the test was 20 dB ISO except at 250 cps, where 25 dB was accepted because of the unavoidable environmental noise in the testing room. Similar procedures have been applied in other investigations (4, 40). During the first year only 3 frequencies were used at testing, during the following two years, 6 frequencies. Calculations from the results of the last two years of examination show that the relative sensitivity of detecting hearing impairments of any origin is 70.5% and the relative specificity 99.5%, when testing at 250, 1000 and 4000 cps. Corresponding figures for testing at 250, 4000 and 8000 cps are 97.4% and 98.6%, respectively (Paper III, Table 3).

Since the screening method is quick and easy to carry out, there is no reason for reducing the efficiency of the test by limiting the number of frequencies used.

Retesting children who fail at the first screening before referring them to an audiologist, and treating them with nasal decongestants between the two tests, seem to be a wise procedure. In this way, the number of overreferred children is reduced to an acceptable point (1.2% of all tested) and the burden on the audiologist is lightened. The professional examination of our control group showed that it is unlikely that many children with important hearing loss were missed at the screening.

V.5. Dental examination

No specific screening test is available for detecting dental disorders. In the clinical examination of caries, gingivitis and malocclusion, certain sources of observational error are inherent, of both systematic and accidental type. However, in this study several steps were taken to reduce such errors.

1. The same dentist, with long clinical experience, performed all examinations.

2. Diagnostic criteria were standardized and the dentist was well acquainted with these criteria from a training period spent together with a paedodontist and an orthodontist, until they were in agreement on their judgment.

3. Methods of recording were also standardized, using specially constructed dental charts for the examination and for the interview.

4. Two equivalent sets of room, equipment and instrumental set up were used during the study, one in Lund and one in Dalby.

5. Ample time was allowed for the examination of each child.

Since an unselected population of pre-school children was examined with these precautions, it seems justified to compare the oral health in different subgroups of the material (e.g. sex, area of residence and socio-economic groups).

V.6. Urinary screening

Examination of the urine is an old and widely used procedure to detect diseases in adults and children.

In pre-school children as well as in school-children the traditional examinations — in popula-

tion studies and in clinical work — are confined to the detecting of glucose and protein in the urine. Lately, however, a growing interest in bacteriuria has also been noticed since evidence is gathering that bacteriuria in childhood merits detection and treatment (66, 47). Several extensive studies of bacteriuria in childhood, especially in school-children, have been published (39, 44, 60).

Only a few surveys of bacteriuria in the pre-school ages have been performed, obviously due to difficulties in obtaining adequately collected urinary specimens.

Different screening methods for bacteriuria have been used for many years. They are of two kinds, chemical and bacteriological (For review see 38). The one used in this study, the glucose method, is based on two well-known facts: the urine normally contains small amounts of glucose, and bacteria consume glucose during their multiplication (62). A test-paper, Uriglox ®, was prepared to react with a colour change to concentrations of glucose of ≥ 2 mg per 100 ml of urine (61). Absence of colour reaction indicates hypoglycosuria, a sign of bacteriuria. As a reference method, quantitative bacteriological cultures were performed by the calibrated loop technique on all children. Standardized procedures for the urine sampling were applied, which is necessary for the proper evaluation of the results, both of the screening method and of the bacteriological culture.

A high percentage of children could follow the instructions for this procedure. The instructions necessary for the screening method were followed

even better than those necessary for the reference method.

By means of these instructions for the collection of urinary samples (first morning urine, midstream samples without prior periurethral cleansing, samples chilled immediately with ice), 71.6% of the first samples yielded "no growth" and the mean frequency of contamination at a level of $> 10^5$ organisms per ml of urine was only 1.2 %, which is as good as or better than that found in studies using more complicated methods of sampling and cleansing.

The agreement between the screening method and the bacteriological culture was excellent: the sensitivity was 100% and the specificity $> 99\%$. To our knowledge, no other method of screening for bacteriuria in children have shown such good results. Several population studies have confirmed these findings (18, 43, 52), while others have found a lower sensitivity (7). Thus, Uriglox ® is suitable as a screening method for bacteriuria in pre-school children. It has now been introduced as a routine method in the county's Child Health Services and schools (38).

The prevalence of bacteriuria among the girls was 0.8%. In the remaining part of the study (children born 1965) Uriglox ® was used as a routine screening procedure, and only those screened positive were checked with bacteriological cultures. Another 3 girls with bacteriuria were then detected, and the prevalence rate of bacteriuria in the whole population was unchanged, 0.8% among the girls and 0% among the boys.

VI. PHYSICAL HEALTH PROBLEMS

The second highest living standard in the world, reasonably well distributed among different socioeconomic groups, and a well organized care of pregnant women, deliveries, neonates and infants must result in physically well developed and healthy children. The findings in this study do not contradict this statement. The children had a good general health: they were taller and heavier than children of corresponding age from other countries (46); the hæmoglobin concentration was generally satisfying and only a few had mild anæmia. Gross

physical disabilities and handicaps were usually detected at an early age. Only in fields not fully covered by the existing Child Health Services, functionally important health problems, previously unrecognized, were found with some frequency, e.g. caries, vision and hearing disturbances.

From the results of the various parts of the health control as presented in Papers I–VI, and from available information about non-attendants the percentages of children with clinical diagnosis

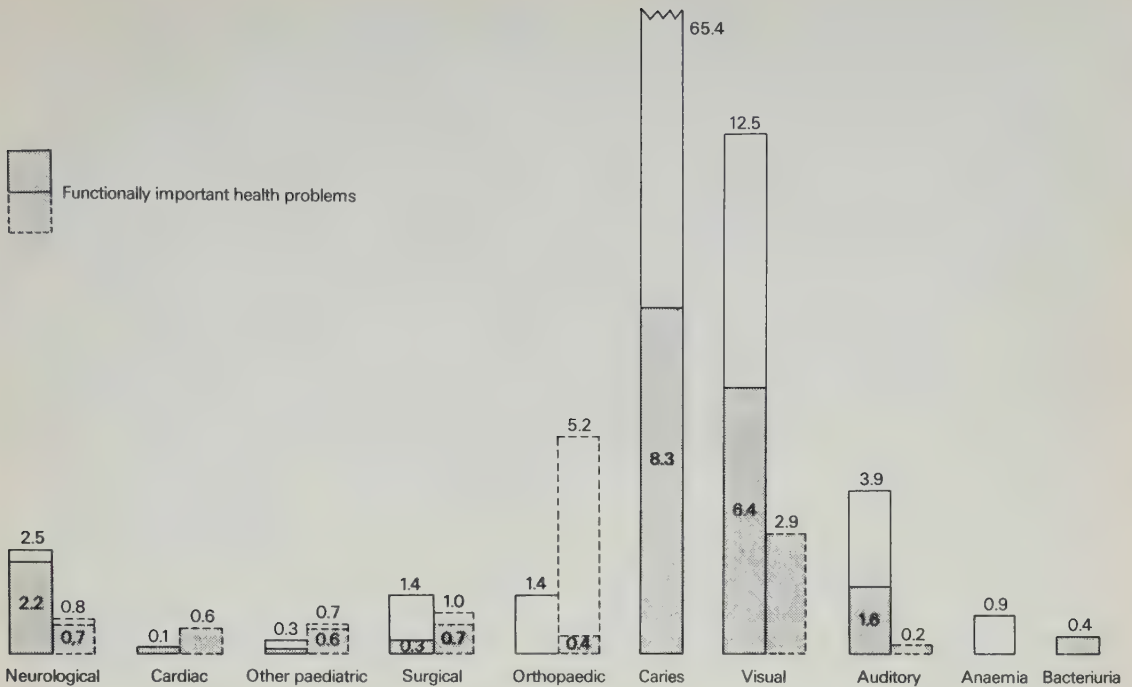


Fig. 2. Percentage of 4-year-old children with present health problems, discovered in the health control (columns within continuous line) and previously known (columns within dotted line).

of present health problems, newly discovered or previously known and cared for, are calculated and shown in Fig. 2. A health problem was considered as previously known if it was diagnosed, treated and controlled by a doctor. In some cases, the parents had suspected a disability but not consulted a physician. These cases were considered as newly detected.

VI.1. Functionally important health problems

Based on the discussions in the original papers, an attempt has been made to evaluate the clinical findings in terms of functional importance for the child. A *functionally important health problem* is here defined as a disorder which is likely to have a significant and prolonged impact on the child's health and development or to hamper the full exploitation of its environment, either at the present or in the future. (For further discussion see below.)

Among the newly discovered *neurological disturbances*, minimal brain dysfunction, hemiplegia and polyneuropathia found in 54 children, were considered to be functionally important deviations

(Paper I, Table 1) and among the previously known neurological disturbances all but hemicrania were considered important (19 children) (Paper I, Table 9 A–F and page 187). Only one child had a *cardiological deviation* of some importance, a post-infectious myocarditis, but all previously known, verified or suspected organic heart diseases (15 children) were considered important (Paper I, Table 9 and page 187). Among the children with *other paediatric deviations*, the 3 with asthma bronchiale, chromosome aberration and a resistant chronic obstipation were included in this group (Paper I, Table 1), as well as the 16 children listed in Paper I, Table 9, H–K, M–N and on page 187.

Among the *surgical referrals*, retentio testis in 8 boys and cheiloschisis in 1 boy were considered important (Paper I, Table 3) and also the diagnoses on 18 children listed in Paper I, Table 10 (Exceptions: 3 boys with phimosis, 2 girls with inguinal hernia, and 1 boy with torticollis). In Paper I, Table 11, all diagnoses except flat-feet and knock-knees were included as functionally important (10 children) but none of the newly discovered *orthopaedic deviations* (Paper I, Table 4).

Table 9. Number of functionally important health problems according to diagnoses

	Among 2 447 examined children		Among 126 non-participating children		Sum	
	n	%	n	%	n	%
Neurological	67	2.7	6	4.8	73	2.8
Other somatic	68	2.8	4	3.2	72	2.8
Cardiac	15	0.6	1	0.8	16	0.6
Other paediatric	16	0.7	3	2.4	19	0.7
Surgical	27	1.1	0	0	27	1.1
Orthopaedic	10	0.4	0	0	10	0.4
Dental	204	8.3	—	—	204	7.9
Visual	221	9.0	7	5.5	228	8.9
Auditory	41	1.7	3	2.4	44	1.7
Bacteriuria	9	0.4	—	—	9	0.4
Total	610	24.9	20	15.9	630	24.5

In the *dental study*, children designated as "emergency cases" were counted as having functionally important health problems, 194 children in the main study group and 10 children in the experimental group (Paper IV, Table 2 and page 6). Malocclusion was not considered to be a functionally important health problem at this age.

The ophthalmological findings in children referred for *visual disturbances* were evaluated in terms of need for professional care, and groups 2–3 were designated as "significant eye disorders" (Paper II, page 18), i.e. an early treatment would be advantageous for the visual prognosis. These 154 children (Paper II, Table 2) were considered as having functionally important health problems, as well as the 74 children with previously known and treated eye disorders (Paper II, page 21).

Most of the newly detected *hearing impairments* were due to conductive hypoacusis. 36 children with severe middle ear infection and 2 with compact cerumen as well as the one with a more serious sensorineural hearing loss (Paper III, Table 1 and page 556) were included in the group of children with functionally important health problems as were 5 children receiving special education due to serious sensorineural hearing loss.

The finding of *bacteriuria* in 9 girls was considered important because of the possible connection with renal disease later in life (Paper VI, page 289). The presence of non-persistent proteinuria was not regarded as important.

The mild *anaemia* in 20 children (Paper I, Table 8) was not considered to be functionally important, since the haemoglobin concentration

was not very low and since the children's general health did not seem to be impaired.

The number of functionally important health problems thus defined in the total population of 4-year-old children is summarized in Table 9.

The concept of health problem and in particular of functionally important health problem is not easily defined or demarcated. Some of our demarcations are rather arbitrarily made, and other investigators with different backgrounds and training, or working under other conditions, could easily find other angles of approach and question our conclusions. For instance, we think that a child at risk of developing amblyopia of one eye has a functionally important health problem. Why is it so important to have full or nearly full sight in both eyes? It is true that he may not qualify for some professions where a perfect stereoscopic vision is necessary, e.g. artillery-officer, but he is not handicapped in his daily life since his visual acuity equals that of the better eye. It is moreover true that he may contract a disease or injure the healthy eye, and thereby be handicapped. Although no figures seem to be available on this specific problem, the risk cannot be too great. Nevertheless, we think that it is important that children should have optimal use of their main information medium, and that a suboptimal function, be it a functional amblyopia or a significant anisometropia, may limit or distort their true conception of the surroundings and cause unnecessary strain.

Such reasoning may be valid in an affluent society where life-threatening epidemics and nutritional deficiencies are eradicated. In other countries

these more subtle views on optimal health should rightly be regarded as a waste of time, energy and money.

The same arguments can be applied to the concept of minimal brain dysfunction, which, furthermore, is a highly controversial subject. Objections have been raised to the assumption that a specific syndrome of hyperactivity, impulsivity and clumsiness, caused by organic brain damage exist at all (19, 20, 54, 58). This condition may instead be associated with any degree of psychiatric, neurological or intellectual impairment (20, 22). Whatever these children are called, they constitute problems for themselves and their surroundings, at the present and in the future. By recognition and treatment, better prospects for their adjustment and function are reached (11, 73).

On the other hand, children with gross cerebral palsy, severe hearing loss, or muscular dystrophias can hardly be disputed as having functionally important health problems.

This implies that widely differing disorders are included in the concept of functionally important health problems with varying impact on the children's health and development. The justification for collecting all these disabilities under one heading is that we believe that they are all in some way or other important for the child and that we have the resources for detecting and taking care of them.

Table 10. *Functionally important health problems found in 2 447 four-year-old children*

	Number of children		Number of health problems	
	n	%	n	%
Previously known and treated important health problems	132	5.4	172	7.0
Newly detected important health problems	437	17.9	507	20.7
Sum of present important health problems	529	21.6	610	24.9

VI.2. *Previously known and newly detected health problems*

Table 10 shows the number and percentage of children with important health problems, divided into previously known and newly detected, as well as the number and percentage of important health problems found in these children.

Furthermore, among the 126 children who did not participate in the study, 15 children had 20 important health problems (Table 9) a figure which slightly augments the percentage of previously known health problems but not that of the sum of present health problems.

Thus, based on these concepts of health prob-

Table 11. *Associations of functionally important health problems among 529 4-year-old children*

Children with	Children with functionally important health problems													
	Neurological		Other somatic		Dental		Visual		Auditory		Bacteriuria		Total	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%
One or more health problems	67	—	68	—	204	—	221	—	41	—	9	—	529	—
One health problem only	44	65.7	43	63.2	164	80.4	175	79.2	31	75.6	8	88.9	465	87.9
Two or more health problems	23	34.3	25	36.8	40	19.6	46	20.8	10	24.4	1	11.1	64	12.1
Combinations:														
+ Neurological	—	—	1	1.5	9	4.4	16	7.2	1	2.4	0	0	23	4.3
+ Other somatic	1	1.5	—	—	11	5.4	10	4.5	4	9.8	0	0	25	4.7
+ Dental	9	13.4	11	16.2	—	—	19	8.6	4	9.8	1	11.1	40	7.6
+ Visual	16	23.9	10	14.7	19	9.3	—	—	6	14.6	0	0	46	8.7
+ Auditory	1	1.5	4	5.9	4	2.0	6	2.7	—	—	0	0	10	1.9
+ Bacteriuria	0	0	0	0	1	0.5	0	0	0	0	—	—	1	0.2

Within each column, the same child may be found in more than one of the combinations, and, thus, the column sum of the combinations may be higher than "two or more health problems".

lems it is calculated that the gross prevalence of functionally important physical health problems in this total population of preschool children was just under 25%, found in 21.6% of the children. Out of these health deviations 28.2% were previously known and cared for. If the dental findings are excluded, the prevalence of health problems will be 16.6%, found in 15% of the children, 42.4% being previously known.

VI.3. Characteristics of the functionally important health problems

It is evident from Table 10 that a certain overlapping between health problems exist, and Table 11 shows the health problems which tend to be associated with each other. To avoid too small groups, cardiac, orthopaedic, surgical and other paediatric health problems are put together as "other somatic health problems".

Most of the children, 87.9%, had only one important health problem. Only one strong association was found among the health problems: significant eye disorders were found more frequently among children with neurological disorders than among children with other disorders or among healthy children. This association is highly significant ($p < 0.001$), and depends on the well-known connection between strabismus and neurological disorders (1, 71). since neurological deviations were not significantly more frequent among children with eye disorders *without* strabis-

mus than among healthy children (4.5% and 2.3% respectively, $p < 0.05$). Thus, children with strabismus could be regarded as being at risk of also having neurological disorders, and vice versa.

Furthermore, children with "other somatic problems" seemed to be at risk of having other types of health problems, too. This association was found in 36.8 % ($p < 0.01$), mostly regarding dental deviations (in 16.2, $p < 0.05$) and auditory impairment (in 5.9 %, $p < 0.05$).

VI.4. Characteristics of the children

In Table 12 children with present important health problems are compared with the rest of the studied child population with respect to sex, residential area (urban or rural) and socio-economic group. These background factors varied considerably according to diagnoses. Slightly more boys than girls were affected with important health problems, although this difference was statistically significant only with regard to neurological deviations. Most other studies of chronic illness in childhood show a preponderance of boys over girls, especially regarding motor disturbances (14, 53, 59, 76).

The finding of more health problems in the rural area (Dalby) than in the urban area (Lund) was consistent throughout the various groups of diagnosis (except "bacteriuria") and statistically significant regarding "dental", "other somatic" and "total" health problems. If the dental findings

Table 12. Percentages of children with functionally important health problems distributed on sex, area of residence and socio-economic group. Comparison is made with the distribution of children without functionally important health problems

Health problems	Background factors									
	Sex			Area of residence			Socio-economic groups			
	Boys	Girls	Difference	Lund	Dalby	Difference	I	II	III	Difference
Neurological	3.9	1.4	***	2.6	3.7	NS	2.0	2.4	3.8	NS
Other somatic	3.2	2.2	NS	2.5	4.9	*	2.0	3.0	3.2	NS
Dental	7.9	8.8	NS	6.8	20.5	***	0.9	7.3	16.6	***
Visual	8.3	10.3	NS	8.9	11.7	NS	8.0	7.4	12.3	**
Auditory	1.7	1.7	NS	1.6	2.3	NS	1.7	1.4	2.0	NS
Bacteriuria (only girls)	—	0.9	—	0.9	0	NS	0.3	1.2	0.8	NS
Sum previously known	5.5	5.3	NS	5.2	6.7	NS	4.2	5.0	7.0	*
Sum newly detected	17.7	17.9	NS	15.9	19.4	NS	9.8	16.2	27.1	***
Total health problems	21.8	21.4	NS	19.9	35.8	***	13.5	19.7	31.4	***

NS = not significant; * = $p < 0.05$; ** = $p < 0.01$; *** = $p < 0.001$

are excluded, the difference of total health problems between the two areas will be significant only at the 5% level (19.4% and 14.5%, respectively).

In Lund, the regular health surveillance of infants and children is performed by paediatricians and registered children's nurses, i.e. by Child Health Centres of type I, while the children in Dalby are surveilled by district doctors and district nurses, i.e. by Child Health Centres of type II (see page 7). It was found that the attendance to the ordinary Child Health Centres during the year before this health control was about the same in Lund as in Dalby (41.9 % and 36.6 % respectively, $p>0.05$).

Since examination of vision, hearing, bacteriuria and teeth was not included in the ordinary health surveillance of smaller children, neither in Lund nor in Dalby, a comparison was made between the two areas regarding "neurological" and "other somatic" health problems, which could be expected to be detected and referred for treatment at the routine medical examinations. The comparison is showed in Table 13. It is found that the frequency of both previously known and newly detected health problems of this kind is greater in Dalby than in Lund, although the difference is statistically significant only regarding the sum (5.1 % and 9.0 %, respectively, $p<0.05$). The interpretation of these figures is that the differences in prevalence are not due to differences in the skills or attention of doctors and nurses at the Child Health Centres but rather to the different structures in the population in Lund and in Dalby. The higher the socio-economic group the parents belonged to, the less frequently did their children have important health problems (Table 12), and families in Lund more frequently belonged to

higher socio-economic groups than families in Dalby or in the country as a whole (see Table 2). The distribution of these health problems on the socio-economic groups did not differ significantly between Lund and Dalby ($p>0.05$).

The dental findings were most responsible for the different prevalence of health problems in the socio-economic groups. If these findings are excluded, the prevalence of total health problems will be more equally distributed and the differences not statistically significant (12.5 %, 13.4 % and 18.9 %, respectively, $p>0.05$).

The significance of social conditions for child health development has been demonstrated in several investigations (For review see 76). Moreover, in a recent sociological study of adult health in Sweden, a similar inequality in health problems was found between the three socio-economic groups (28).

VI.5. Comparisons with other studies

Comparisons with other epidemiological studies on child health are difficult, often impossible, due to substantial differences in populations, definitions and methods.

Nevertheless, Pless & Douglas (53), in summarizing several epidemiological studies of child health, state that there seem to be a general agreement that the total prevalence of chronic conditions in most populations under 20 lies between 10 and 15 %. Our results of 15 % of the children with functionally important health problems support this view. However, if the dental findings are included, as is hardly ever done in other studies, the figure is instead 21.6 %. Furthermore, psychological and educational health problems are not included in this part of the report, and they will undoubtedly increase the number of affected children.

Reports, although less detailed, from two smaller and differently designed Swedish studies on 4-year-old children have been published (5, 74). Both found few serious somatic deviations that were not known before. Visual and auditory disturbances were rather common. One of the studies (5) found a prevalence of caries and malocclusion very similar to ours. The influence of socio-economic factors on the children's health was reported for caries, nutrition and mental development (5).

Table 13. *Distribution of "neurological" and "other somatic" health problems in 2 179 children in Lund and 268 children in Dalby*

"Neurological" and "other somatic" health problems	Lund		Dalby		Difference	Sum	
	n	%	n	%		n	%
Previously known	56	2.6	12	4.5	NS	68	2.8
Newly detected	55	2.5	12	4.5	NS	67	2.7
Total	111	5.1	24	9.0	*	135	5.5

VII. CONCLUSIONS AND IMPLICATIONS

The recording of prevalence, nature, background, and associations of physical health problems in a preschool child population is of real interest only when the experiences and results can be applied in practical routine work to improve Child Health Services. It is necessary that research is built-in to the planning of health services. Research and planning are both indispensable elements in the creation and maintenance of an effective service. In the report from the extensive study of children on the Isle of Wight (59) this view is expressed in the following way: "In the absence of research we can only move forward blindly, able to profit neither from our mistakes nor from our successes. Research and planning need to go forward hand in hand so that the questions for research can arise from problems in service provision and the findings from research can be taken into account when planning further services." This outlook may also be twisted into: "All action that is unevaluated is an experiment but carried out in such a way that we cannot learn from the experiment" (30).

The necessity of a "production control" has largely been overlooked in Child Health Services, and very few efforts have been made to evaluate what is really done and accomplished in the daily routine work at the Child Health Centres.

In certain respects the present study provides such an evaluation. By a thorough and comprehensive point examination of the total preschool population at the age of 4 years, the ability of the existing services to detect and provide care for important health problems could be assessed. At once, it could be concluded that these services function very well in selected fields of child health, but that other fields of physical health are not covered, mainly dental disorders, vision and hearing defects and bacteriuria. For the time being, however, no safe and simple screening methods exist for detecting visual and hearing disturbances or bacteriuria, until the child is able to cooperate, i.e. at the age of 3–4 years. Dental health has hitherto been badly neglected, as is shown by the fact that the vast majority of the children in our study had caries, and that a considerable number were designated as emergency cases.

The dental study (Paper IV) also shows that the

introduction of rather simple preventive measures at an early age can produce a significant reduction in caries at the age of 4 years. Therefore, another conclusion is that a program for caries prevention must be included early in the general health services for children, where an extensive proportion of the population is reached. The design and content of such a program is outlined in Paper IV, and it is now being introduced all over the county.

For vision, hearing and urine testing, methods and procedures have been evaluated. From this evaluation and from the findings in the study, it may be concluded that screening of vision, hearing and, for the girls, bacteriuria are important items to include in the routine health services, and that 4 years is a suitable age to perform this screening, which, however should be repeated when the children begin school.

It does not seem motivated to perform screening for proteinuria or hyperglucosuria at the age of 4 years.

The results of the paediatric examination were rather sparse. Only 2.7% of the children had newly detected important health problems at this examination (left part of Fig 2; Table 13) and although they are considered important, they are not handicapping to the same extent as the disorders already detected (Paper I, Tables 1, 3–4, 9–11). Under these circumstances the question may be raised as to whether a thorough clinical examination by a paediatrician is a necessary or worthwhile procedure in a health control of this kind. Much time, money and effort could be saved if some form of screening could be applied between the child and the physician also regarding these types of physical disabilities.

This type of screening could be made by delegating the initial health appraisal to nurses or other health workers. Several studies on adults (31) and children (9, 51, 64, 65) have demonstrated that such physical appraisals can be as effective or even more effective than those made by physicians. Also, questions posed to parents, teachers or to patients themselves on printed questionnaires or by non-professional interviewers have been able to identify subjects at high risk of having health problems (17, 75). The questionnaire used in the present study (see section V.1,

pages 14–15) undoubtedly gave much valuable information about the children and their background and also identified some children "at risk". However, it was found that the questionnaire in the present form was not selective enough to be suitable as a screening instrument.

There are other aspects of the medical examination than the mere case-finding to be considered, aspects that are not easily measured or evaluated. A personal contact was established with the children and with the parents, many of whom had not visited a Child Health Centre for a long time. Advice, support and treatment were offered for minor health problems, and since problems perceived as relevant by the parents, whether they are or they are not in objective medical terms, appears to be important to the child (24) it could well be that patient satisfaction and relief of discomfort were valuable outcomes of this medical examination.

These more subtle aspects of health care are not necessarily neglected, if some of the work the paediatrician is now doing is done instead by specially trained nurses, using structured forms and manuals for interviews and for physical examinations.

A study of the efficiency and acceptability of such a program is now being performed in Lund and Dalby.

This kind of health appraisal could probably be used for other ages also, and the paediatric resources could be saved for more urgent tasks, e.g. examining newborns and infants.

The few cases of mild anaemia (0.9%) do not motivate that haemoglobin measurements are performed as a routine at this age. This investigation should instead be saved for children with anamnestic or clinical suspicions of anaemia.

The behavioural aspects of child health and its relation to physical deviations are not mentioned here, since they will be the subject of separate reports to be published shortly (35, 36). However, the need for advice, guidance and assistance in matters of up-bringing is great, and since this is also a neglected area of child health services, a reinforcement and enlargement of these activities will be an urgent task for the future services (34, 37).

If the health control gave many valuable results from the point of view of the "producers" of child

health services, it was also highly esteemed by the "consumers", clearly shown by the high rate of participation. The uncooperative families were few, some of them moreover having acceptable reasons for not participating.

However, since it was found in the examination that children from lower socio-economic groups ran a particular risk of having important health problems and since the non-participating families had a poorer socio-economic background, it is concluded that still more effort must be made to encourage all families to participate in the Child Health Services throughout the children's pre-school years.

A study like this will answer some questions about child health and its services, but it will also inevitably give rise to many other questions and be an incitement for further research. Thus, a follow-up of these children when they begin school at 7 years of age will provide us with valuable information and serve as a further evaluation of the health control at 4 years of age. A follow-up of children treated for significant eye disorders offers unique possibilities for assessing the value of early treatment and for evaluating the proposed classification of eye disorders. A follow-up of the children with malocclusion e.g. at ten years of age, could provide valuable information about the persistence of malocclusion and its relation to sucking habits. Introduction of health appraisal by nurses as discussed above must be evaluated.

The possibilities of detecting functionally important health problems at an even earlier age could be investigated by reviving the concept of "newborns at risk", using a more structured and standardized classification at birth and then examining the children at 4 years and at 7 years of age.

These research projects are now being realised at the Child Health Service in Lund.

The important question as to whether the results and experiences of this local study are applicable to other parts of the country or to the whole country was briefly discussed in section III.1. It was found that the structure of the society, the level of education, and the social conditions of Lund and Dalby differed from those found in other parts of the country, and, therefore, that the findings of child health in these areas may not

simply be generalised to other areas. The results from other smaller pilot studies of the health control, all performed in cities with good opportunities for specialised medical care (5, 74) are largely similar although they may differ in detail. It is probable that the health of preschool children in more densely populated areas does not diverge too much from the picture given in this study. Comparative studies from greater rural areas are still lacking, however. The organization of this study with its centralized investigations may be suitable in medium-sized communities with good communications. In big cities or in sparsely populated areas, other types of organization may have to be considered.

The most important conclusions and implications from this study may be summarized as follows:

1. In contrast to the ordinary Child Health Services for preschool children, this health control succeeded in achieving a very widespread participation, presumably by offering an investigation that was recognized by the parents as being important for their children's health.

2. Still greater efforts should be made to attract the interest of the non-attendant small minority of parents.

3. By screening vision, hearing and, for the girls, bacteriuria, a reasonable number of important deviations were detected. The age of 4 years is suitable for this screening, but it should be repeated at school.

4. A program for the prevention of caries should be introduced at the Child Health Services at a very early age. The age of 4 years is far too late.

5. The thorough paediatric examination revealed rather few children with unknown functionally important health problems, especially when compared with the time-consuming and expensive method of examination. Most severely handicapping disorders were already detected and cared for. Other methods should be tried to detect children with physical health problems.

6. The questionnaire did select some children at risk of having functionally important health problems but was not selective enough to be of value as a screening instrument.

7. Routine hæmoglobin measurements are not necessary at this age.

8. Screening for hyperglucosuria, proteinuria and, in boys, bacteriuria is not motivated at this age.

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